Veterinary Public Health Collaborations: An Essential Component of Future Public Health Preparedness

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A Master's Paper submitted to the faculty

of the University of North Carolina at Chapel Hill

in partial fulfillment of the requirements for the degree of

Master of Public Health in the Public Health Leadership Program

Chapel Hill

2008

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Veterinarians protect the public's health by serving in multiple roles as epidemiologists, food inspectors, and veterinary medical officers in local, state, federal, and military organizations. One of the more prominent roles that veterinarians play in the public health arena is preventing and controlling rabies by vaccinating domestic and wild animals. However, newly emerging diseases that are influenced by factors such as changing climates, global travel, international trade, bioterrorism, environmental and demographic shifts, and antimicrobial resistance are creating new public health challenges for the future. Although veterinarians possess a unique set of training and educational skills that would allow them to address these challenges and to make significant impacts on efforts to protect the public's health, there is concern among some veterinary and public health leaders that the types of veterinary collaborations and partnerships that will be needed to adequately protect the public's health in the future have not been organized and implemented. There is also a concern among some leaders in the public health arena that veterinarians may not be positioning themselves to take advantage of developing opportunities. This paper seeks to explore these complex, multi-disciplinary veterinary public health collaborations, provide evidence to support the development of such partnerships, demonstrate the framework for such partnerships, and give examples of existing veterinary public health collaborations.

Veterinarians have typically played important roles in protecting the public's health by serving as veterinary medical officers at food processing plants in the Food Safety and Inspection Service to ensure food safety or for the Animal and Plant Health Inspection Service(APHIS) of the United States Department of Agriculture(USDA). These veterinarians work in regulatory

roles with various governmental agencies to prevent animal disease and to promote food safety by inspecting, testing, and quarantining animals shipped into the United States for brucellosis, tuberculosis, and bovine spongiform encephalopathy or Mad Cow Disease (1). They also serve as epidemiologists, scientists, or veterinary medical officers for the United States Public Health Service(USPHS) or the Centers for Disease Control where they investigate disease outbreaks such as West NileVirus(WNV) and perform research on other zoonotic diseases. Veterinarians also serve in roles as public health officers in the Army Veterinary Corps or the Biomedical Corps the Air Force while performing research, providing care to specialized military pets or to pets of military personnel. They work at the Food and Drug Administration(FDA) evaluating new drug and vaccine development(1). Veterinarians also work with agencies such as the National Institutes of Health and the Environmental Protection Agency. In light of the terrorism incidents of September 11, 2001, veterinarians now work at the Department of Homeland Security helping to develop anti-terrorism and biosecurity procedures and protocols (1).

It iscommon knowledge among the public that veterinarians serve in some of these public health roles as well as the roles that veterinarians play in preventing the spread of rabies by vaccinating domestic and wild animals. Although the public is becoming more aware of the contributions that veterinarians have made to public health, there is still a lack of full awareness of the diverse roles of veterinarians in public health (2). However, within the leadership ranks of veterinary medicine, there is a growing recognition of the unique skills that veterinarians have to contribute to improving public health's ability to prepare for, respond to, and mitigate emergencies (3).Yet, newly emerging diseases that are influenced by factors such as changing climates, global travel, international trade, bioterrorism, environmental and demographic shifts, and antimicrobial resistance are issues that are creating new public health challenges. Despite the

numerous roles that veterinarians currently serve in public health, some public health officials are not convinced that the veterinary profession is preparing itself to assume leadership roles on important public health issues. In a letter to the editor of the Journal of the American Veterinary Medical Association, Dr. Joseph Butterweck, a Diplomate of the American College of Veterinary Preventive Medicine, suggested that "veterinary public health will become irrelevant unless the profession makes some long overdue changes" such as refocusing its efforts to the needs of society such as chronic diabetes as opposed to continuing to focus on traditional diseases such as rabies(4**).** In his own words, "If we are not careful, rabies will be the albatross of the veterinary public health profession. We need to move on to more important issues that will benefit more of the population that pays the bills**"** (4).

Some of the new opportunities that are emerging for veterinarians to help improve public health include communicable diseases; non-infectious diseases; human-animal relationships; leadership and management of community, state, federal, and international health programs and public health departments; and support in the design and efficacy analysis of public health programs (3). New opportunities for veterinarians in public health also include developing methods to improve food security and safety, develop better vaccines for zoonotic diseases, perform clinical research in zoonotic diseases, creating effective anti-viral agents, developing rapid and effective diagnostic tests. Collaborative research between HHS, USDA, local and state health agencies, and universities with input from veterinarians will be required to successfully address current and future challenges (3). In a commentary, Dr. Kenneth Moritsugu, the former Acting U. S. Surgeon General, he stated that "Our ability to surpass the health challenges that we face today will require a collaborative effort. The partnerships that veterinarians and public health practitioners form today will help inspire that collaboration and improve the future health

of America and the world"(5).

Although veterinarians make up approximately 1 percent of the public health workforce, recent educational and policy issues have renewed the interest in increasing the number of veterinarians in public health challenges (6). There have been many reports about a shortage of veterinarians that are available to serve in public health roles. For example, a report that was published in1989 by the Pew Charitable Trusts on a study of the veterinary profession indicated that there was a serious shortage of veterinarians in public sector specialties (2). There is currently a shortage of veterinarians in food safety, food and animal production, biosecurity, and research (3). Results from a symposium that was held in Davis, California May 9-11, 2002 and attended by sixty-six veterinarians and other health professionals included concluded that there is an urgent need to increase the number of veterinarians with skills in animal population health, leadership, multi-disciplinary teamwork, and with broad perspectives on issues of environmental/human/animal health and well-being that are capable of effectively working in public agencies, private corporations, animal production industries, and other organizations that involve such issues (7). There are many individuals who believe that there is a pending shortage of veterinarians in public practice and some estimates predict that at least 20% of new veterinary graduates would have to enter public practice in order to satisfy the national need (8). However, most of today's veterinary graduates prefer to enter private clinical practice.

There is a consensus among future employers of public-health veterinarians that: (1) the current needs for public-health veterinarians exceed the existing supply (2) needs will continue to grow as the value of veterinarians in public health is more widely recognized and (3) educational opportunities in public health must be expanded in order to produce graduates who possess the critical competencies necessary for public-health practice (8). This perceived

shortage of public health and food animal veterinarians resulted in the introduction of a bill in Congress entitled the Veterinary Public Health Workforce Expansion Act of 2007 which called for the establishment of a competitive grant program to build capacity in veterinary medical education and to expand the workforce of veterinarians serving in public health and biomedical research (9). A number of educational and training programs have also been implemented at various institutions and agencies to address this shortage of public health veterinarians. For example, on December 5-6, 2002, key officials of the American Veterinary Medical Association, the Association of American Veterinary Medical Colleges, and the deans of more than half of the veterinary schools in the United States met with staff members from the Centers of Disease Control and Prevention(CDC) to discuss the issues that are simultaneously impacting human and animal health. The goals of this meeting were: (1) to increase the veterinary community's understanding of programs at CDC and the multiple roles that veterinarians play throughout the agency (2) to provide CDC with an opportunity to gain insight into current issues in veterinary medicine as well as public health perspectives of veterinarians and (3) provide a forum for discussions on ways to increase collaborations between human and veterinary medical communities to address critical public health needs (10).

The urgent need for veterinarians in public health positions and the important roles that they play in the public's health can be understood if one considers that (1) 38,000 animals cross the borders of the United States daily (2) the illegal exotic animal trade is estimated to be approximately $4 billion to $6 a year and (3) the US food agricultural system represents 12 percent of the gross domestic product and (4) 21 billion animals are produced for food and fiber around the world (11). A global perspective on the importance of public health veterinarians can be appreciated if one considers that livestock contributes to the livelihood of approximately 70%

of the world's poor (12). In the Summary of Discussions on Public Health Systems (Section A) from its annual meeting in 2003, the Institute of Medicine (IOM) stated that there is a need for increased linkages between the worlds of public health and clinical medicine, as well as greater linkages with veterinary medicine (13). Perhaps, veterinarians are vital to our very existence.

Prior to 1988, veterinarians were not considered to be members of the public health system (14). There is no consensus on the meaning of veterinary public health beyond 'diseases' and there is a need for a more coherent and defined understanding of the profession (14). The World Health Organization defines veterinary public health as "The sum of all contributions to the complete physical, mental, and social well-being of humans through an understanding and application of veterinary medical science" (12). This is a broad definition and it includes multiple facets of health and its determinants. It also provides a wide range of opportunities for veterinarians to make significant contributions to public health. The concept of veterinary public health began in ancient Egypt where healing priests did not draw a distinction between caring for patients and caring for animals and this practice of "one medicine" was continued into the 19th century (12). The first public health program was founded at the USPHS by Dr. James H. Steele, a former assistant Surgeon General and pioneer in veterinary public health leadership(15). Dr. James Steele was also a pioneer in the One Health initiative and he formed partnerships with physicians to make advancements in controlling and preventing zoonotic diseases in the United States and internationally (16).

Zoonotic diseases are diseases that can be transferred from domestic or wild animals to people. Some of the emerging health threats include diseases transmitted from animals or zoonotic diseases and through reservoirs such as insects, food, and water as well as resulting from environmental toxins, the misuse of antibiotics, and bioterrorism (10). These health threats

are influenced by factors such as the daily interactions of animals and humans in the environment as well as international travel, urbanization, the shipment of animals and animal products, a global economy, climate changes, national and global security, the management of complex food and fiber systems, and wildlife interactions (10). According to the World Health Organization(WHO), approximately 75% of the new diseases that have occurred in humans over the past 10 years were caused by zoonotic pathogens or those originating from animals or from products of animal origin (17). It has also been estimated that approximately 60% of infectious agents are zoonotic and that zoonotic pathogens are twice as likely to be associated with emerging or new infections compared to a non-zoonotic pathogen (18). It has been estimated that 80% of the biological agents that are classified as"category A" because they can easily be spread from person to person and are considered to pose major risk to national security are zoonotic (11). Of the 1700 pathogens that affect humans, 49% are zoonotic while 73% of The 156 pathogens that are associated with emerging diseases are also known to be zoonotic (3).

Scientists that study infectious diseases have found that Acquired Immune Deficiency Syndrome(AIDS) makes people more susceptible to zoonotic diseases such as bovine tuberculosis, toxoplasmosis, cryptosporidiosis, food borne Salmonella and enteric infections such as Campylobacter, Listeria, and Yersinia (19). Considering that AIDS is a global disease, these factors could have a significant impact on international health outcomes. Some of the emerging viral diseases that have a rodent or unknown animal host have caused some fatal and devastating diseases in humans in Africa and South America such as Lassa Fever and South American Hemorrhagic diseases in Argentina and Bolivia (19). The Ebola Virus hemorrhagic fever and Marburg hemorrhagic fever virus infections that have occurred in Africa have been linked to monkey disease and have caused disease in medical personnel, handlers, and people who had

only casual exposure (19).

Approximately 63% of all US households own at least one pet (18). This level of pet ownership along with high rates of infection with Toxocara infection creates significant environmental contamination with Toxocara eggs that serves as a potential source of infection for humans, particularly children because of their play habits (20). Because of the strength of the human-animal-bond which is defined by the Center for the Human-Animal Bond as "the dynamic relationship between people and animals in that each influences the psychological and physiological state of the other", pet owners have closer relationships and more daily interactions with their pets today than in the past (21). Pet owners often consider their pets to be "members of the family" and their veterinarian to be "the other family doctor". As a result of the strength of this bond, pets often live inside of households, sleep in bed with their owners, and also travel with the family. Therefore, there is an increased risk of the transmission of a zoonotic infection if a pet is infected or contaminated with a zoonotic organism. For example, one study found that Toxocara canis or roundworms is common in urban children and may be associated with adverse neuropsychological effects (18).

The author has detected zoonotic intestinal parasites in pets during fecal analyses on routine physical examinations of companion pets. This finding is particularly troublesome when these observations are made in puppies or kittens that belong to families with young children or immunocopromised individuals such as those receiving chemotherapy or those with chronic illnesses. Although it is recommended that pregnant women do not handle cats or their litter pans, the author has observed a number of pregnant females handle cats even though there is an increased risk of contracting pathogenic organisms such as toxoplasmosis from infected cats. A recent national survey of dogs in animal shelters demonstrated that helminthes that are important

causes of disease in dogs or humans such as Toxocara canis, Ancy;ostoma spp., and Trichuris vulpis are common across the country (20).

Millions of pet owning families also have exotic pets such as turtles, snakes, hamsters, and monkeys. Some of these pets carry dangerous infectious pathogens and these can be potentially harmful to pet owners, young children, or immunocompromised adults. For example, the 2003 monkeypox outbreak that occurred in the Midwestern United States occurred in individuals who owned prairie dogs that had been infected with the monkeypox virus by Gambian rats while they were stored in a pet distribution facility (18). **N**early all reptiles carry Salmonella in their intestinal tracts and exposure to these animals leads to almost 100,000 cases of reptile-associated salmonellosis in the United States each year (18). Zoonotic diseases also pose risks to workers who work in food processing plants and come in contact with the pathogenic agents that cause such infections. For example, Campylobacter is a bacterial infection that can be transmitted to workers that are employed at poultry processing facilities and Streptococcus is a bacterial infection that can be transmitted to pig farmers (18)**.** Although animal exposures play an important role in zoonotic disease transmission, a study found that physicians are not comfortable discussing the role of animals in the epidemiology of zoonotic diseases and prefer that veterinarians play a role in this process (18). Veterinarians in private clinical practice that have daily interactions with millions of pet owners can play a major role in preventing zoonotic diseases by educating pet owners about the risk of contracting zoonotic diseases and the preventive measures that they can take to avoid infection. Veterinarians are considered to be the best source of information about pets and good veterinary practice should include providing information to clients about potential zoonotic disease risks and how to avoid them (20). Public health veterinarians can also play a larger role in providing preventive

education to workers who are predisposed to such infections.

Veterinarians and physicians could form partnerships to monitor and advise pet owners who are chronically immuonocompromised or those who have pets that are imunocompromised (18). Either group would theoretically be more susceptible to opportunistic infections by pathogenic organisms such as bacteria and yeast (18). For example, some pets have allergic skin or immune-mediated gastrointestinal and eye conditions and they receive immunosuppressant medications such as corticosteroids, cyclosporine, and azathioprine (18). Many of these pets are owned by families with young children or family members who are immunocompromised (18). Partnerships can be formed between public health agencies, animal breeders, physicians and private veterinary practitioners to collect data on the distribution and epidemiology of parasites in a given locale. Protocols could be developed to inform pet owners and potential pet owners about the risks involved with owning pets and the precautions that should be taken to avoid infection (18). Physicians should advise immunosuppressed individuals, or healthy individuals with children, that they should not own or have contact with reptiles because the Salmonella in their gastrointesinal tracts can not be eradicated (18). Physicians and veterinarians should instruct patients and clients, respectively, on the importance of carefully washing their hands after handling pets (18). For example, The CDC has a "Pet-Scriptions" guidelines on its website for physicians and veterinarians to distribute to their patients and pet-owning clients on ways to reduce zoonotic diseas risk (18).

There should be increased communication between physicians and veterinarians regarding human, pet, and wildlife health because such direct communication between physicians, epidemiologists and veterinarians could help to expedite a rapid response particularly in states where the local public health agencies either do not exist or are not involved in zoonotic

disease surveillance (18). For example, a more rapid response may have resulted during the WNV outbreak in New York in 1999 if improved communication between veterinarians, epidemiologists, physicians, and public health authorities had revealed that veterinarians had observed an increased number of dying crows and other birds in surrounding areas (18). The link between human and animal illness was discovered by a veterinary pathologist at the Bronx Zoo who recognized that dying crows were usually resistant to St. Louis encephalitis(SLE) which had been the presumed etiologic agent in the outbreak (22). The benefit of joint surveillance is evident if we consider that the recognition of the first human case of H5N1 avian influenza in Hong Kong in1997 was facilitated by the surveillance of ducks, geese, and chicken in southern China in previous years (22).

During 16 years of private clinical veterinary practice, the author has noted that there is not a collaborative or coordinated effort among veterinarians, physicians, and public health agencies in preventing zoonotic diseases. When parasites with zoonotic potential are discovered in companion animals, there is not an established protocol or communication process that allows veterinarians to collaborate with physicians to alleviate the fears of pet owners who are concerned about infestation in family members. If a geographic location had a surveillance or reporting process that allowed data on zoonotic diseases to be gathered and distributed to veterinarians, physicians, residents, breeders, pet stores and public health agencies in a respective area, preventive strategies could be established and implemented to prevent such infections. For example, a municipality could distribute a small flyer in its utility bills that would serve as an educational tool for local residents.

The CDC has established the National Center for Zoonotic, Vector-Borne and Enteric Diseases(NCZVED) to address the trend of emerging zoonotic diseases (**See appendix A)**. This

center is headed by Dr. Lonnie King, a public health veterinarian, former veterinary school dean, administrator and public health leader. Dr. King is an excellent example of the type of veterinary public health leader that is needed to help prepare public health organizations for future public health challenges. The goal of the new National Center for Zoonotic, Vector-Borne and Enteric Diseases (NCZVED) at the Centers for Disease Control and Prevention has set a goal to maximize public health and safety nationally and internationally through the prevention and control of disease, disability, and death caused by zoonotic, vector borne, waterborne, mycotic, and related infections (23). In order to accomplish this mission, the Center will seek to form partnerships with organizations such as the Association of American Veterinary Medical Colleges and the Association of Schools of Public Health. According to Dr. Lonnie King, Director of the NCZVED, this type of collaboration is urgent because most significant global epidemics are zoonotic and an ecological approach is needed to understand them and to prepare for further problems (23). In his testimony to the Committee on Homeland Security Subcommittee on Prevention of Nuclear and Biological Attack of the U.S. House of Representatives, Dr. King stated that "NCZVED will provide leadership, expertise, and service in laboratory and epidemiological science, bioterrorism, preparedness, applied research, diseases surveillance, outbreak response, policy development, health communication, education and training, and program implementation and evaluation" (24).

Public health could benefit from collaborative research by veterinarians, physicians, and medical researchers. Veterinarians have made significant contributions to the advancement of human health by participating in research that helped to advance medicine, establish treatment protocols, and develop surgical procedures. Knowledge and applications that are acquired or developed by performing research on animals are often extrapolated or applied to humans. There

are also medical applications used in humans that are applied to animals. Veterinarians have also made numerous contributions to public health and can be credited with helping to control malaria and yellow fever, solving the mystery of botulism, helping to produce an anticoagulant that is used to treat people with heart disease, identifying the cause of West Nile Virus, helping to develop surgical procedures for humans such as hip and knee joint replacement, and limb and organ transplants(1**).** According to comments made by Dr. Stephen F. Sundlof, the former Director of the Center for Veterinary Medicine, "Veterinarians, because of their in depth knowledge of certain biomedical specialities, combined with their broad understanding of biomedical research, are more uniquely suited to do biomedical research" (25).

Veterinary research provides numerous opportunities for improving animal and human health and unforeseeable challenges can be addressed more effectively with a competent and properly equipped veterinary research community (26). Veterinary research has interfaces with human and animal health and it is interdisciplinary(26). Therefore, collaborative and interdisciplinary research is crucial in translating scientific advances from one traditional discipline to another (26). For example, biological models are needed to develop safer and more preventive methods for biological agents and veterinarians are needed to develop and improve the understanding of these animal models as well as the comparative pathology between humans and animals (3)**.** An example of the need for such collaboration is the establishment of the Center for Comparative Medicine and Translational Research at the College of Veterinary Medicine at North Carolina State University which has a mission to "enhance collaborative, translational, interdisciplinary approaches for the comparative study of animal/human diseases"(27). Veterinary science research includes topics such as the prevention, control, diagnosis, treatment of diseases and the basic biology and welfare of animals as well as

experimental models of both human and animal disease and relevant research at important human-animal interfaces such as food safety, wildlife, ecosystem health, zoonotic diseases, and public safety(26).

According to a report published by the National Academies of Sciences in 2005 entitled Critical Needs for Research in Veterinary Science, "Research in veterinary science is critical for the health and well-being of animals, including humans (26). Food safety, emerging infectious diseases, the development of new therapies, and the possibility of bioterrorism are examples of issues addressed by veterinary science that have an impact on both human and animal health". (26). However, there is a lack of scientists engaged in veterinary research because too few veterinarians pursue research careers, and there is shortage of facilities and funding for conducting research (26). The urgent need to provide adequate resources for investigators, training programs, and facilities that are involved in veterinary research must be met to take advantage of opportunities to improve the well-being of humans and animals and to minimize risks to their health (26)**.** We must build upon the knowledge base of the veterinary sciences and use translational-research capacity to make next-generation therapeutics, vaccines, and diagnostics for such pathogens as Foot and Mouth Disease, influenza, anthrax, SARS, and other important future threats (3). One of the recommendations made by the National Academies of Sciences in its report is that the veterinary research community should facilitate and encourage collaborative research across disciplines, institutions, and agencies by reducing administrative barriers and by nurturing and rewarding successful team-oriented investigators (26). A strong workforce of veterinary researchers is needed to provide the type of information that is required to make informed decisions on matters that govern day-to-day activity in animal health and welfare – decisions that underlie the economic stability that is necessary for adequate national

animal health care (26).

Potential contributions from veterinary research on public health and food safety :

- Improving detection and surveillance of food-borne pathogens associated with livestock and poultry production.

- Developing interventions to reduce the dissemination of such pathogens.

- Understanding mechanisms of the development of antibiotic resistance among food-borne pathogens in the food chain.

- Developing surveillance pre-harvest and post-harvest surveillance systems, diagnostic and detection systems, vaccines, immunomodulating drugs, animal and product tracking systems, and ecologically sound methods of the disposal of animal carcasses.

- Improving our ability to detect and identify disease and pathogens in animal populations populations and our understanding of interactions between pathogens and hosts so that effective preventive and control measures can be developed. (26)

Veterinary medicine and environmental public health have long had many common competencies, practices, and accomplishments and it may be useful to reintroduce this important professional partnership in consideration of emerging public health challenges (6). For example, veterinarians also work in environmental health programs studying pesticides, industrial pollution, and other contaminants and they also work with governmental agencies such as the FDA studying new chemicals and feed additives (1). Changes in land use, the use of large terrestrial and marine food production units, and the microbial and chemical pollution of land and water sources have created new threats to both animals and humans (6). Veterinarians and environmental health scientists can use their unique partnership to develop and apply sustainable and effective community health interventions by working together to investigate the environmental antecedents that lead to adverse health outcomes and by strengthening

epidemiologic and laboratory investigations that assess the role of environmental influences (6). **V**eterinarians' understanding of biological interaction, their clinical experience, and their roots in preventive medicine makes them ideal partners for environmental health service (6).

Some veterinarians practice wildlife medicine and are involved in ecosystem management to provide an important service that is necessary for maintaining diversity of the species as well as protecting the environment and the public from public health threats. For example, sea otters in California have struggled to survive for many years and their existence was threatened by an unknown cause (28). It was only after veterinarians became involved and an integrated research process involving a multidisciplinary approach involving pathology, parasitology, epidemiology, and molecular biology was applied that Toxoplasmosis was discovered as being one of the major causes of death in these sea otters (28). Veterinarians are also involved in monitoring wild birds and other fowl for signs of Avian Influenza (28). Wildlife medicine is an integral part of the "One World-One Health" concept and new opportunities for wildlife veterinarians arise daily and prospective employers of wildlife veterinarians are looking for advanced training beyond the DVM or VMD degree (28).

If one considers the education, training, and comparative medical background of veterinarians in toxicology, microbiology, and pathology, it is evident that veterinarians are important stakeholders in studying, preventing, controlling, and eliminating zoonotic diseases. Considering the similarities of animals and people, their responses to medicines, environmental stimuli, surgical procedures, and their interdependence, it would seem logical for individuals who provide care and services to the both of them would collaborate on common issues to benefit "the good of the whole". Our increasing interdependence with animals and their products may be the single most critical risk factor to our health and well-being with respect to infectious

diseases (29). This theory of One Health was supported by William Osler and Rudolph Virchow, who was considered to be the Father of Comparative Pathology, and it was further articulated by Calvin Schwabe in "Veterinary Medicine and Human Health" in 1984 (29).

With the explosion of information, advances in technology and research, and limited availability of resources, it is difficult for some organizations to effectively perform their functions independently and efficiently. Considering the complexity of newly emerging diseases, the specialization of science and medicine, multi-disciplinary teams will be needed in the future to effectively address and resolve future public health issues. Such collaborative partnerships could expand their operating capacity by sharing their technology, manpower, resources, grant-writing responsibilities, and technology. Separate missions can be accomplished with shared visions. For example, there is evidence of mergers, "buy-outs", and the formation of partnerships throughout the financial, medical, educational, airlines and other industries. Perhaps, there are a number of opportunities for veterinary public health collaborations that will allow veterinarians to form partnerships with other professionals who have common interests in preparing for future public health challenges. According to Louis Rowitz, a professor at the School of Public Health at the University of Illinois and Director of the Mid-America Regional Public Health Leadership Institute, "In an effective partnership, the partners share a vision, are committed to the integrity of the partnership, agree on specific goals, and develop a plan of action to accomplish the goals" (30).

The re-emergence of zoonotic diseases along with other issues such as bioterrorism, pollution incidents, antimicrobial resistance, xenotransplantation, , and the socioeconomic importance of food production, make a collaborative interprofessional approach to veterinary public health more urgent (12). Multidisciplinary teams that are comprised of all of the stakeholders who contribute make contributions to the treatment, control, and prevention of

diseases of animal origin are essential, not only to determine the source of disease but also to assess the risk of outbreaks and to make recommendations for future control (12). In a commentary by Dr. Kenneth Moritsugu, he stated that "Prevention and preparedness are inherently important to both veterinary medicine. They represent a shared federal, state, and local responsibility. We need to come together to create a seamless preparedness network, where we are all working together to improve our nation's health" (5).

The AVMA created the One Health Initiative Task Force on April 14, 2007 in order to study the possibility of a campaign to encourage collaboration and cooperation among the health science professions, academic institutions, federal agencies and industries to assist with the assessment, treatment, and prevention of disease transmission across multiple species (16). According to Dr.Lonnie J. King, "Achieving the end point of One Health is truly one of the critical challenges facing humankind" (16). Perhaps, the One Health Initiative is a broad and comprehensive framework for future collaboration between veterinarians, physicians, researchers, academic institutions, public health practitioners, and other public health stakeholders. The One Health task Force of the AVMA is recommending the formation of an independent, multi-disciplinary collaboration between veterinary medicine, human medicine, and public health (31). This initiative will seek to improve the public health infrastructure at the local, national and international levels by recruiting the expertise of every veterinarian and human health provider in the United States (31). The One Health Initiative would allow a collaboration of multi-disciplinary specialties that would benefit humans, animals and the environment (16). Such collaborations would provide the type of comprehensive and innovative strategies that will be needed to address the global health challenges of the future. (**See Appendix for the full scope of One Health Initiative)**

The One Health Initiative will allow a collaboration of multi-disciplinary specialties that will benefit humans, animals and the environment. Such collaborations would also allow a sharing of expertise and information by learning institutions. Veterinarians are well trained in population health, comparative medicine, preventive medicine and they have the training, skills, and knowledge to help lead the Health One Initiative, (16). Therefore, the veterinary medical profession has a responsibility to assume a major leadership role in the multi-disciplinary efforts between human medicine, environmental science, public health, and bio-engineering (16).

The Benefits of a One Health Initiative (31)

1. Improving animal and human health and addressing critical needs globally through collaboration of all health sciences, especially the veterinary and human health medical professions

2. Meeting new global challenges head-on through multi-disciplinary collaboration between veterinary medicine, human medicine, environmental health, wildlife health, and public health

3. Developing centers of excellence for education and training in specific areas through improved collaboration between colleges and schools of veterinary medicine, human medicine, and public health

4. Increasing the number of professional opportunities for veterinarians

5. Expanding upon the scientific knowledge available to create innovative programs to improve health

Health Risks Concerns of the One Health Initiative (31)

The adaptation of microbes

Global travel and transportation

Terrorism

Changes in the climates

Economic development and land use

Human demographics and behavior

A collapse of public health and animal health infrastructure

Poverty

Social inequality

The Vision for One Health

Vision Statement – To promote and improve the health of humans, animals and our environment, individually and collectively, by encouraging and ensuring the acceptance of One Health and its associated activities.

Definition of "One Health" – One Health is the collaborative effort of multiple disciplines-working locally, nationally, and globally to attain optimal health for people, animals and our environment.

The Scope of "One Health" – The scope of One Health is impressive, broad, and growing. See **Appendix of the scope Executive Summary(Executive Summary – An Imperative ….)**

Examples of One Health Initiatives (30)

Centers for Disease Control(CDC) – created a National Center for Zoonotic, Vector Borne and enteric Diseases(NCZVED) which has interdisciplinary programs in water-borne, zoonotic, and vector-borne diseases as well as global health that integrates human, animal, and environmental

domains in research, disease and outbreak investigations, laboratories, pathogen discovery, epidemiology, policy, and communication.

The Environmental Protection Agency(EPA), United States Agency for International Development(USAID), Wildlife Conservation Society(WCS), Envirovet Summer Institues, and National Science Foundation(NSF) - have established programs and research projects that address environmental degradation, pollution, climate changes, ecological stress, and their impacts on health.

United States Public Health Service (USPHS), the Food and Drug Administration (FDA), the United States Food Safety and Inspection Service (FS IS), and the CDC - have integrated programs that link human and animal health.

The Global Center for One Health and the Center for Emerging Infectious Diseases – have been established as focal points to promote collaboration between disciplines, professions, and colleges together.

US Veterinary/Human Colleges – more than half of the veterinary colleges have established formal dual Doctor of Veterinary Medicine (DVM or VMD)/Master of Public Health (MPH) degree programs to address public health issues.

Veterinary and Human Medical Colleges – have facilitated collaboration across the health professions by forming partnerships with schools of public health and creating programs in comparative medicine and biomedical research. The development and use of animal models for research on treatments and cures for human diseases such as genetically engineered mice have been successful.

Integrated Laboratory Systems – laboratories such as the Integrated Consortium of Labaratory Networks, National Animal Health Laboratory Network, laboratory Response Network, ArboNet, Global Avian Influenza Network for Surveillance, the National Biosurveillance Integration System, and the Food Emerging Response Network.

Human/Animal Health Corporations and Pharmaceutical Companies – such organizations in the Kansas City corridor are sharing capacities and innovations that link the biosciences and animal health while conducting Research and Development systems that utilize human and veterinary medical professionals.

One Health research, data, and programs - are often highlighted in educational journals such as Eco Health, Journal of Emerging Infectious Diseases, Zoonoses and Public Health, and the Public Health Reports Journal.

Animal Welfare Organizations - organizations such as Delta Society have worked to promote human and animal health through the human-animal bond by facilitating human interactions with pets for the benefit of human health.

Federal H51N Avian Influenza(AI) Interagency Planning – the US preparedness efforts to address the threat of AI has become more integrated through planning, surveillance and laboratory strategies, and test exercises.

Public Health Stakeholders – veterinarians, health care organizations, public health agencies, and other stakeholders are collaborating in areas of mutual interest such as pet and childhood obesity and the exposure of pets to secondhand tobacco smoke.

Examples of One Health Initiatives in Academic Settings (30)

1. **Colorado State University -** is addressing global health challenges through "superclusters", an alliance of experts in research, engineering, business and economics that are focused on improving the quality of life by promoting the application of research outcomes to global needs in the areas of infectious disease, cancer, and clean energy.
2. **University of California Davis** – has established an Avian Influenza School to form collaboratives with veterinary and human medicine specialists to improve detection and response to avian influenza outbreak, an Emergency Preparedness and Response project to develop relationships and plans to improve disaster planning and surge capacity for effective human health response, and Calvin Schwabe Center for One Medicine to increase diversity at all levels in the future veterinary student body to reflect that of the nations's and to prepare and support veterinary students for professional careers in One Medicine.

3. **University of Minnesota** – has established a Global Food Safety System Leadership coures that will seek to explore the critical competencies for leadership in industry, government and academia that is necessary for ensuring an abundant, affordable and safe global food supply. The university has also established the Envirovet Summer Institute that helps students prepare for careers in wildlife health and conservation, public health, and ecosystem restoration and recovery.

4. **University of Wisconsin-Madison School of Veterinary Medicine** – has established One Health/One Medicine Initiative by integrating the four primary health sciences schools on campus(human medicine, veterinary medicine, nursing, and pharmacy) along with the Nelson Institute for Environmental Studies, the Center for Sustainability and the Global Environment, the LaFollette School of Public Health Affairs, the law and business schools and others to provide a multidisciplinary education and training to in public health concepts and methods to future health professionals.

5. **North Carolina State University** – has partnered with the North Carolina Department of Health and Human Services, the North Carolina Department of Agriculture and Consumer Services, and other partners to sponsor an annual One Medicine Symposium to educate and provide attendees with practical tools that they can use to enhance preparedness for a natural or man-made disaster or infectious disease outbreak.

6. **The Ohio State University** – has formed a collaborative with the colleges of Biological Sciences, Food, Agricultural, and Environmental Sciences; Medicine, Pharmacy, Public Health, and Veterinary Medicine. The purpose of this collaborative is to protect public health by minimizing animal to human, environmental, and food borne infectious disease threats through broad innovative interdisciplinary research. For example, the James Comprehensive Cancer Center is a model for interdisciplinary research (Executive Summary One Haelth)

7. **American Association of Veterinary Medical Colleges (AAVMC)/American Society of Public Health (ASPH) Collaborations** – this partnership has held a joint symposium on research and education in veterinary public health to promote a connection between public health and veterinary medicine and relevant issues such as population health, zoonotic diseases, food safety, and food security. The symposium focused on finding ways that schools of public health and colleges of veterinary medicine can work together to improve academic programs, public policy, workforce training and research.

Evidence of veterinary public health collaboration has been observed globally. For example, a unique example of collaboration and cost effective health intervention between public health and veterinary services is the Expanded Programme on Immunization, a child vaccination program in southern Sudan that shared cold chain equipment with veterinary services and also used the vehicles of veterinarians to implement the vaccination campaign (32). There is also evidence of collaboration between veterinarians and local public health organizations. The City of Milwaukee's Health Department, under the umbrella of the Department of Homeland Security Urban Area Initiative (UASI), has created a workgroup to begin the integration of veterinarians and other animal health professionals in regional public health emergency preparedness and response planning. The primary goals of this initiative is to: (1) develop county emergency operation plans (EOP's) that describes the roles and responsibilities of animal health professionals in emergency situations (2) develop an alert messaging and information system (VetNet) for real time dissemination of risk communication (3) provide of local training opportunities for animal health professionals and (4) assess the current veterinary capacity and

infrastructure as part of a regional resource inventory. By including veterinarians and other animal health professionals in regional emergency planning through the UASI workgroup, the overall Milwaukee local public health agency response to zoonotic diseases should be strengthened (33).

The Bioterrorism Preparedness Program within the Department of Health and Human Services that provides guidance to states and municipalities identifies preparation needs that demand strong partnerships between those responsible for human health as well as those who are responsible for animal health (3). These include:

- undertaking risk and vulnerability evaluations
- assessments of food and water to include evaluation of production, processing, and distribution
- assessment and strengthened links with the animal surveillance and the animal health community
- developing critical public health infrastructure and core capacities to ensure that communities and states can detect and control infectious diseases
- serving at the forefront of research of all aspects of zoonotic pathogens

Veterinarians are essential shareholders in our nation's efforts to protect its food sources, its environment, and its vital resources. They have made significant contributions to the public's health and well-being. Although public health veterinarians have served in traditional roles and theses duties have been considered the norm, future public health challenges will require that public health leaders "think outside of the box" and be innovative in assigning roles in the public health system. This will require creativity in organizing and implementing comprehensive and effective preventive and public health strategies. This means that public health officials will have

to consider the unique educations, training, skills, and resources of all public health stakeholders. In light of today's budget cuts, "downsizings", reorganizations, and limited resources, public health organizations should consider forming more partnerships with veterinarians to expand the capacity of the public health workforce. The One Health Initiative is a basic framework and foundation that can be utilized as a model to build veterinary public health collaborations for the future public health challenges. Considering the unique comparative medical training of veterinary graduates, their understanding of the ecological framework of disease models, an increase in zoonotic and food-borne diseases, and the complexity of future public health challenges, veterinarians should be at the forefront of public health preparedness. Although veterinarians are an under-utilized resource and new opportunities are developing that will require their expertise, they must not be passive and wait on calls to become public health servants. In the words of Dr. Margaret Pappaioanou, "It is time for we veterinarians to broaden our perspective on our profession and then step up to the plate and implement our vision with confidence and commitment" (8). Therefore, the veterinary profession must proactively seek the opportunity to "take a seat at the public health table" by organizing and building its constituency, informing the public of its unique skills and training, and convincing relevant decision-makers that these skills are compatible with the urgent needs of man, animals, and the environment, and vital for future public health challenges.

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